CSIR NEWS

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MYSORE

Micro-reactor Unit for Catalytic Activity & Reaction Mechanism Studies

The final phase of the development of a catalyst is the testing of its activity, selectivity and life. One very convenient new technique to study the catalytic reactions is the micro-test using a few millilitres of catalyst material and micro-litre amounts of reactants. With a view to establishing a facility for studying primary and secondary conversion processes involving the use of catalysts, a micro-unit with built-in analytical facilities has been set up at the Indian Institute of Petroleum (IIP), Dehra Dun. Since a number of such processes involves the use of high pressure and hydrogen, the unit has been designed and fabricated for 100 kg/cm² hydrogen pressure and a maximum operating temperature of 600°C.

Pure compounds representative of the industrial feedstock are processed in this unit containing 1-5 ml of the catalyst. The unit is coupled directly to a gas chromatographic column and a detection system in series. It can also be coupled directly to a mass spectrometer.

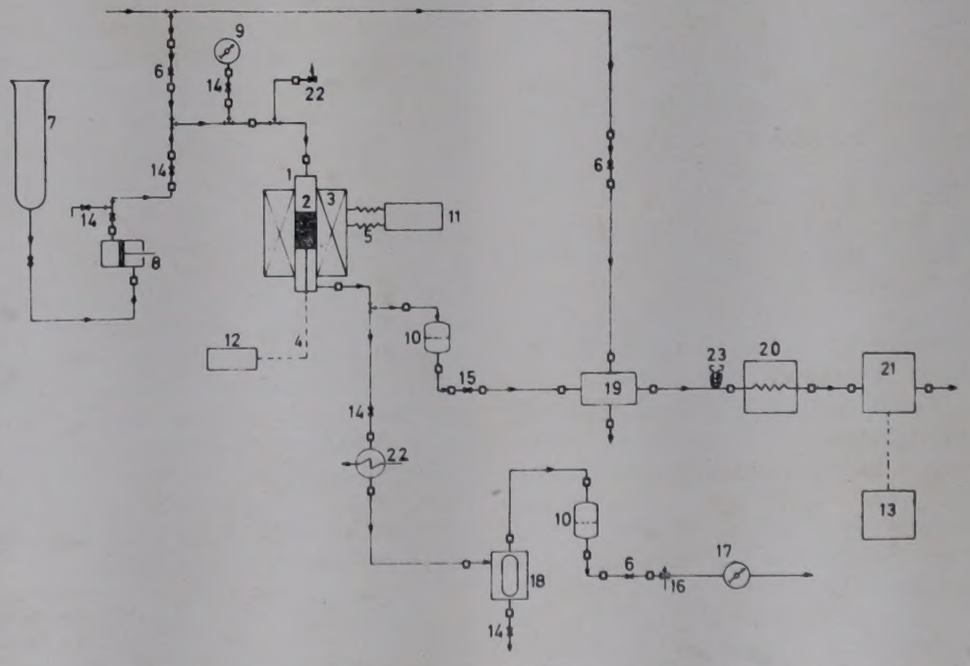
Apart from providing rapid analysis of the products the unit is useful for determining kinetic order activation energies (and hence for studies on reaction mechanisms) and heats of adsorption. It is also being used for rapid screening of a large number of catalysts for their relative activities and selectivities. By the method of 'accelerated aging' in which a catalyst is deactivated under severe operating conditions, a rough idea of the life of a chosen catalyst can be obtained before it is subjected to life tests on pilot plants under normal plant operating conditions for periods ranging up to 5000 hr.

The typical operating conditions are as follows: catalyst volume (ml), 0.5-4.0; feed range (ml/hr), 5.0-0.8; length of bed (cm), 0.7-5.7; and space velocity (v/vh), 0.20 (min) and 10 (max).

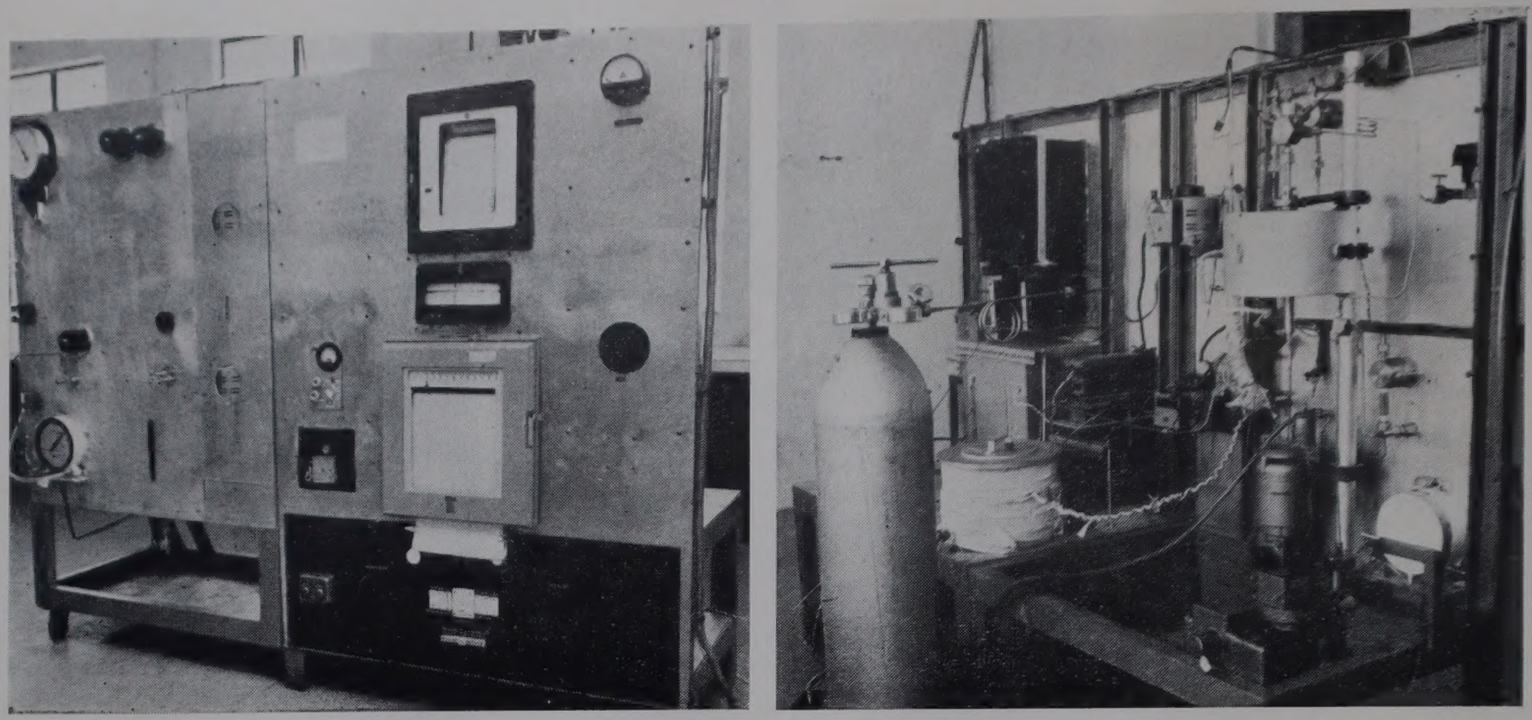
The reactor effluent is separated into two flows. The major part flows through a cooler and is fed into a high pressure separator (18) where gas and liquid phases are allowed to separate. The liquid phase accumulates and is removed periodically for determining the average conversions. The gas phase passes through a pressure reducer (6) to the control valve (16) and finally through a gas meter (17).

A small branched part of the reactor effluent goes to the chromatographic column maintained at a desired temperature in a column chamber (20) via a flow controller HP/HT valve (15) and a loop type injection valve (19). The loop of the injection valve is calibrated, and in stand-by position, the reactor effluent flows in the loop and is vented, while carrier gas flows through the other available port of the valve. In injection position, the carrier gas flows into the calibrated loop and flushes the corresponding volume of the reactor effluent towards the chromatographic column and the detection cell.

The detection cell (21) is placed in series with the column which is then connected to a thermal conductivity bridge. The product tube-lines are heated and maintained at a desired temperature. The electrical signal delivered by the bridge is registered by the recorder (13) which is equipped with a disc integrator for peak area measurements. One injector block (23) is also provided in series with the gas chromatographic column in order to select,



PROCESS FLOWSHEET OF MICROTEST UNIT [(1) Stainless steel reactor; (2) Catalyst bed inside reactor; (3) Heating furnace; (4) Thermocouple coaxial; (5) Thermocouples; (6) Pressure reducer (valves); (7) Feed storage; (8) Feed pump; (9) Pressure gauge; (10) Filter; (11) Temperature control; (12) Recorder; (13) Recorder (1mV) with disc integrator; (14) Needle valves; (15) HP/HT valve; (16) Control valve; (17) Gas meter; (18) HP separator; (19) Injection (sampling) valve; (20) Column chamber; (21) Detection cell (bridge); (22) Safety valve; (23) Injector block; and (24) Cooler]



Micro-reactor unit with built-in analytical facilities for studies on catalytic activity and reaction mechanism studies set up at IIP, Dehra Dun: Front view (*left*)-recorder; Back view (*right*)-reactor assembly

standardize and calibrate a particular column, and to determine the average conversions.

The possibility of coupling a multiple system of micro-test units is presently being worked out.

PROGRESS REPORTS

NAL Annual Report : 1969-70

A highlight of the annual report of the National Aeronautical Laboratory (NAL), Bangalore for the year 1969-70, published recently, is the successful completion of the laboratory's major project on the design, fabrication, erection, commissioning and calibration of the 4-ft trisonic wind tunnel. The tunnel was released for industrial development work. Testing of models up to Mach number 2.4 of various configurations of an aircraft of interest to aeronautical industry was taken up during the year.

In the field of structural sciences, the laboratory's activities were mainly in the following areas: aeroelasticity, structural mechanics, fracture mechanics and fatigue. The stress analysis of a tail-plane was completed by the matrix method. The spar deflections obtained by this method were comparable to the experimental results obtained by the Hindustan Aeronautics Ltd.

In the field of materials science, the technology of fibre reinforced plastic composites has been engaging the attention of the laboratory during the past few years. A prototype of a large filament winding machine capable of fabricating cylinders of maximum diameter of 60 cm and maximum length of 220 cm was built and tested during the year. The machine can also be used for light turning operations necessary for making mandrels. The machine was put to use successfully for fabricating a wind tunnel model of a power station smoke stack for the Central Water & Power Commission and an insulator column for 110 kV circuit breakers for the Mysore State Electricity Board. An improved version of the smaller filament winding machine developed earlier was fabricated and supplied to a firm. The machine can fabricate shells with a maximum diameter of 44 cm and length of 137 cm.

A detailed investigation of cracks in welded steel members of an aircraft was undertaken at the instance of the Hindustan Aeronautics Ltd and the Department of Civil Aviation and a suitable welding process, which eliminates cold or hot cracking, was suggested. A diffractometer for measuring residual stresses in large components made of light alloys was developed. The instrument uses a geiger or a scintillation counter as a detector.

Bench scale experiments on the preparation of chromium from a hexavalent bath were completed and the equipment for batch production was designed. A sensitive method of estimation of nitrogen in chromium (<0.1 ppm) was standardized.

In the field of propulsion, the computer programme for calculating the boundary layer on cascade, developed during the previous year, was modified to take into account the initial laminar boundary layer region. A loss coefficient for cascades in incompressible flow can be quickly determined using this programme if there is no significant separation. A test rig for the investigation of flame stabilization of diffusion flames of butane gas, using opposed jet as a flame holder, was commissioned. A number of experiments were carried out to determine the blow-off velocity as a function of air-to-fuel ratio using different geometric configurations of opposed jets working at various injection pressures. It was found that for diffusion flame of butane gas in ambient air the maximum blow-off velocity measured was 57 ft/s near about the stoichiometric ratio. Inclined jets issuing from the periphery of the test

section were more effective for flame stabilization than the centrally located opposed jet. In view of the encouraging results obtained it is proposed to investigate aerodynamic stabilization under conditions representative of combustion in afterburners of duct burners of air breathing engines.

In the field of electronics, a notable development was the design and fabrication of a small solid state temperature controlled oven for accommodating integrated circuit operational amplifiers and other critical components of a circuit. The oven maintains a constant temperature of 60°C±1°C for ambient variation from 10°C to 55°C. An advantage of the oven is that it enables the use of an inexpensive integrated circuit amplifier for critical applications where only chopper stabilized dc amplifier is used. A useful addition to the computer system of the laboratory was the development of a paper tape comparator duplicator, which enables comparison of two programme tapes for character-to-character identity. A high energy ignition system for jet engines and a full-wave phase controlled lamp dimming circuit using silicon controlled rectifiers are the other developments made by NAL in the field of electronics.

A completely automatic instrumentation system for excitation of natural resonant modes in complex structures, a load measuring system for high load ranges, instrument systems for data collection, signal conditioning and information handling and a hydraulic servo-control system for the 10-ton fatigue testing machine were the significant developments made by the laboratory in the field of instrumentation.

In mathematical sciences, the laboratory was engaged in research in shock structures and aerodynamic flow problems in subsonic, transonic and hypersonic regimes. The structure of strong shock waves was investigated and profiles were obtained for the thickness of the shock and the variation of thermodynamic parameters across the shock for various Mach numbers. A programme for the subsonic lifting surface theory was completed in the Sirius and Fortran languages. Investigations on hypersonic laminar boundary layer for large Prandtl numbers showed that the heat transfer rate increases enormously in the presence of large pressure gradients. A two-dimensional electrolytic tank with hyperbolic bottom was fabricated for the simulation of the stream function in axisymmetric flow.

Seven types of electrical transducers and associated measuring instruments, valued at about Rs 2.02 lakhs, were produced on the pilot plant. Multi-channel data logging systems, temperature controllers, single and multi-channel dc amplifiers, logic circuit modules, shaft position encoders, digital displays and regulated dc power supplies, worth about Rs 2.75 lakhs were also produced on pilot plant.

Two patents were filed during the year under review. One was concerned with self-excited linear variable transformer as displacement sensing device and the other was in respect of heart beat rate measuring instrument. LVDT type pressure and displacement transducers, strain indicator and thermocouple amplifier are being manufactured by two firms under licence from NAL.

The laboratory published 12 technical notes and 36 research papers during the period.

CSIR SUPPORT TO RESEARCH

New Schemes

Electronic Structure of Solids using Mössbauer Effect

The Mössbauer effect is extremely useful in detecting minute changes in the energy of the gamma rays and as such becomes a sensitive tool in investigating the purturbations caused by chemical and structural environments. The technique is employed in studying localized impurities with a view to understanding the electronic structure of solids. Under the purview of the Physical Research Committee, a new CSIR scheme has been granted to Dr K. Rama Reddy (principal investigator) of the Department of Physics, Aligarh Muslim University, Aligarh. It is proposed to make a study of iron (in dilute amounts) present in octahedral and tetrahedral complexes like MgO, ZnO and ZnS. The studies include the temperature dependence of the hyperfine interactions, spin-lattice relaxation rates and the external field dependence of the hyperfine interaction which are expected to facilitate the elucidation of the electronic structure of the ground state in these complexes. Further, these studies will lead to the understanding of the defect solid state.

In view of the importance of iodine in the phenomenon of solid state and to understand its electronic structure in crystalline environment, it is proposed to observe Mössbauer resonance in various iodides to establish a relation between isomer shifts and quadrupole splittings for each oxidation state. It should be possible to evaluate the relative electron densities at the nucleus for different ionic states of iodine.

Light Scattering and Raman Effect and Temperature Variation of Directional Properties of Crystals

A new CSIR research scheme has been granted to Dr N. Rajeswara Rao (principal investigator) of the Department of Physics, Osmania University, Hyderabad. Under this scheme Dr Rao proposes to investigate: (1) Rayleigh and Brillouin scattering of crystals at temperatures up to and a little beyond melting point; and (2) polarization characters of Raman lines in specified directions of crystals at temperatures up to and a little beyond melting point. It is also proposed to set up a laser refilling unit for helium-neon lasers.

Motional States of Polar Impurities in Solid State Matrices

Recent experimental investigations on hydrogen halide molecules in rare gas matrices and OH^- and CN^- impurities in the ionic matrices show a number of spectral features which are not attributed in terms of simple models. It is expected that such polar impurities execute two or three different types of motions which are strongly coupled to themselves and also to the lattice vibrational motion of the surrounding lattice points. The motional states of polar impurities in solid state matrices forms the subject of study of a new CSIR scheme sanctioned to Dr Gopal Krishna Pandey (principal investi-

gator) of the Department of Physics, University of Allahabad, Allahabad. A detailed study of these motional states provides valuable information on the strength of the crystalline field at the impurity site as well as on the intermolecular forces in the solid state. The results of the proposed project have wide applications in view of the fact that such systems have been recently proposed as good refrigerants for producing extremely low temperatures (below 4°K).

Technology of Thin Film Devices and their Application in Microelectronics

With the advent of microminiaturization, many of the new solid state devices such as integrated circuits and thin film devices have come up. In such devices, the active layer or film is very thin and, therefore, small voltages applied across it result in a high electric field. Hence it is essential to understand thoroughly the various electronic processes under high electric field for these devices before they can be used as circuit elements. The object of a new CSIR research scheme sanctioned to Dr S. K. Srivastava (principal investigator) at the Department of Electrical Engineering, Institute of Technology, Banaras Hindu University, Varanasi, is to study the technology of thin film devices and their application in microelectronics. Recently, the compound semiconductors of II-VI group have gained importance due to their photoconductive, electro-optic and electroacoustic properties. These properties are made use of in fabricating photo-diodes, photo-transistors, ultrasonic generator and detectors, etc. However, these devices have not yet been completely developed in the form of thin films and therefore they offer a promising field for development.

Emission and Absorption Spectra of Polyatomic Molecules

A new CSIR research scheme has been sanctioned at the Department of Physics, Gorakhpur University, Gorakhpur under the purview of the Physical Research Committee. Dr C. P. D. Dwivedi, the principal investigator, proposes to study the Raman, vibrational and electronic spectra of polyatomic molecules in different phases; the spectra of molecules in crystals; and the stronger bands of the spectra of polyatomic molecules under higher dispersion and resolution.

High Resolution Spectra of Diatomic Molecules

One of the most important methods for investigating the structure of molecules is by a study of molecular spectra. From the spectra, the various discrete energy levels of molecules can be derived directly and from their energy values one can obtain detailed information regarding the motion of electrons and the vibration and rotation of nuclei in a molecule. The studies have led to the understanding of the nature of chemical valence, forces between atoms and molecules, heats of dissociation and the geometrical arrangement of the nuclei. Molecular spectral studies have also led to the detection of a large number of molecular species which are not chemically stable. The study of rotational structure has, however, been limited to small molecules because of the nonavailability of instruments of high resolving power. The study of the high resolution spectra of comparatively heavier diatomic and simple polyatomic molecules will be the objective of a new CSIR scheme sanctioned at the Department of Electrical Engineering, Institute of Technology, Banaras Hindu University, Varanasi. The principal investigator is Dr O. N. Singh of the Applied Physics Section, who proposes to carry out the studies using a 35 ft concave grating spectrograph having 30 000 lines/in (ruled area 6 in). The theoretical resolving power is 1 80 000 in the first order and its multiples in higher orders. For sources of excitation a high frequency Raytheon microtherm, a power transformer and a high voltage dc power supply will be used.

Optical Properties of Metals and Alloys

Optical properties of metals and alloys give direct experimental evidence in favour of the theoretical conclusions concerning energy state of electrons inside metals and alloys in the light of quantum theory of metals and alloys. With the development of solid state physics, there has been a revival of interest in the study of the optical properties of metals and alloys. The object of a new CSIR research scheme, granted to Dr K. N. Prasad (pincipal investigator) of the Physics Department at the Science College, Patna University, Patna, is to set up an apparatus capable of measuring optical constants of metals and alloys accurately in the visible and ultraviolet regions; to measure optical constants of as many metals and alloys as possible; to use optical data to calculate energy states of electrons inside metals and alloys to interpret and verify theoretically calculated energy states; and to study critically the different theories of the optical properties of metals and alloys with a view to bringing experimental and theoretical results as close as possible. Sarvashri S. N. Prasad and B. S. Lal of the Department will be his associates in the investigation.

Electronic Spectra of Polyatomic Molecules in Near Ultraviolet

The object of a new CSIR research scheme sanctioned at the Department of Physics, University of Gorakhpur, Gorakhpur is to investigate the electronic spectra of polyatomic molecules in the near ultraviolet region (400-200 mμ). The principal investigator is Dr S. N. Pandey of the Department, who proposes to make a study of the electronic spectra of substituted benzenes in the near ultraviolet region. Since all unsaturated groups and heteroatoms carrying a lone pair of electrons are potential chromophores, a study of n-π, n-σ transitions will also be made. A study of conjugated chromophores, which shift the corresponding absorption to longer wavelength, is also included under the scope of the research scheme.

Chemiluminescent Reactions: Spectroscopic Study

The gas phase reaction between the vapour of an alkali metal and a halogen or halide is very rapid, resulting in the formation of molecules or radicals in excited electronic states yielding strong chemiluminescent emission. Such studies will lead to extensions of known band systems, discovery of new electronic states, measurement of population inversions and determination of the nature of the potential curves for excited states.

Under the purview of the Physical Research Committee, a new CSIR scheme has been granted to Dr Chandra Mani Pathak (principal investigator) at the Department of Spectroscopy, Faculty of Science, Banaras Hindu University, Varanasi. It is proposed to set up an apparatus (i) to study various chemiluminescent reactions of untried organic and inorganic halides with potassium and sodium leading to new spectroscopic data; and (ii) to obtain new spectroscopic data on the low-lying energy states of some species by infrared spectroscopy. It is also intended to excite the species formed to higher energy states by passing a transformer discharge across the flame with a view to obtaining spectroscopic data on higher energy states.

Critical States in Binary Liquid Systems: Ultrasonic Study

Commonly measured thermodynamic properties like temperature, pressure, density and compositions in binary liquid systems generally satisfy the laws of thermodynamics which apply to bulk fluids. But there is considerable fluctuation in the properties in the critical region. Optical methods used for the determination of critical properties are not exact as the light waves used for these studies have much smaller wavelengths than ultrasonics. The object of a new CSIR scheme granted to Dr M. G. Seshagiri Rao (principal investigator) of the Department of Physics, Regional Engineering College, Srinagar is to determine critical temperatures in binary liquid systems using ultrasonic methods. Critical temperatures in the binary liquid systems are computed from the temperature variation of either ultrasonic velocity or absorption in the components of the mixture. The temperature variation of velocity is studied by a fixed-path double crystal interferometer to a high degree of accuracy. From this study the critical temperatures for different proportions of the components in the mixture can be determined.

Metal Complexes of N-Hydroxy Compounds

The ultimate objective of a new CSIR research scheme sanctioned to Dr B. C. Battacharyya at the Department of Chemistry, Jadavpur University, Calcutta is to prepare effective fungicides and bactericides based on metal complexes of N-hydroxy compounds. The principal investigator proposes: (1) to develop new chelating agents of N-hydroxy compounds; (2) to isolate their metal (having fungicidal properties such as Mn, Fe, Co, Ni, Cu, Zn, Hg, Al, Sn and oxocations of Ti, Zr, V, Nb, Mo, W, etc.) complexes and study their physical properties to elucidate the nature of bonding; (3) to evaluate the formation constants of these complexes by different physical means and to compare the values of the thermodynamic functions; (4) to study the complexes also in solution by physicochemical means; and (5) to carry out microestimations of the metal ions with the chelating agents so that the uptake of the metals or ligands or the complexes by the microorganisms or the host plant could be estimated directly and easily.

Studies on Mixed Ligand-Metal Chelates

Mixed complexes containing three or more types of groups are frequently formed in solution. These complexes have been studied much less in comparison to simple mononuclear species. A biological system may contain a number of metal ions as well as a number of coordinating ligands and consequently a variety of mixed complexes can be formed. Hence a knowledge of the stability constants of such complexes would lead to a better understanding of the biological processes in addition to possible application in analytical chemistry. Dr M. H. N. Srivastava of the Chemistry Department, University of Allahabad, Allahabad proposes to study, under a new CSIR research scheme granted to him, complex systems in detail to find out whether mixed ligands chelates are formed. The stability constants will be determined and the influence of other ligands on the stability of a simple metal chelate will be studied. Spectrophotometric, infrared and solvent extraction methods will be made use of for the study.

Donor Properties of Oxygen, Nitrogen and Sulphur Atoms in Complexes of Heavier and Inner-Transition Elements

The large cationic radii of the inner-transition metal ions and the shielding of their f-electrons make their cation-ligand attractions largely electrostatic in nature. One may therefore anticipate that the stable complexes of the inner-transition metal ions should be derived from ligands containing strong electronegative donor atoms like oxygen. In fact, the solution stabilities of inner-transition metal complexes of organic ligands have been measured only for those ligands in which at least one oxygen atom acts as a donor. The lack of N-coordinated complexes of these metal ions has been ascribed partly to the fact that nitrogen donating ligands would form unstable complexes with these elements, and also to the fact that many such ligands, basic in nature would precipitate the hydroxide of these metals from their solutions. Recently, however, several workers have shown that nitrogen can also act as a donor towards these metal ions. From the comparatively larger atomic radius of sulphur and its lower electronegativity when compared to that of oxygen, one should expect that sulphur containing ligands will form less stable complexes than those containing oxygen and their affinity for these metal ions may be closer to the ligands containing nitrogen. Studies of inner-transition metal complexes with sulphur containing ligands are meagre. However, because of low values of formation constants it has been proposed that no bond formation through the sulphur atoms occurs in these complexes. It is therefore proposed to undertake a detailed study of comparing the stability of the inner-transition metal complexes formed with oxygen, nitrogen and sulphur containing ligands. The studies will be carried out under a new CSIR scheme sanctioned at the Chemistry Department, Meerut College, Meerut. Dr A. K. Srivastava and Dr P. C. Jain of the Department are the principal investigator and co-principal investigator respectively. The work will involve: (1) isolation and characterization of the complexes of substituted derivatives of some nitrogen, oxygen and sulphur containing donor ligands with several metal ions; (2) recording of the infrared spectra of the solid complexes with a view to finding out the nature of the metal-nitrogen, metal-oxygen and metal-sulphur links and determining the comparative strength of these links

in various metal complexes; (3) measurement of the magnetic moment of the isolated complexes on powder form in order to establish the oxidation state and the magnetic behaviour of these central metal atoms; these studies would also lead to the evaluation of spin-orbit coupling constant for the central metal ions in the complexed state; (4) recording of the electronic absorption spectra of the isolated complexes in solution for determining the stereochemistry of the complexes; evaluation of relevant ligand field parameters, e.g. ligand field splitting energy, ligand field stabilization energy and Racah's parameters, will also be attempted; (5) EPR spectral measurements on the complexes to obtain the value of Lande's splitting factor; (6) spectrophotometric measurements of metal complexes formed in solution to determine the composition, stability constant and free energy change of formation of the complexes; and (7) *p*H and conductometric titrations to study the nature of the complexes in solution and to compare their stability with that of a variety of oxygen, nitrogen and sulphur donor ligands.

Chemical Investigation of Some Xerophytic Plants of Rajasthan

Under a new CSIR research scheme sanctioned at the Department of Chemistry, University of Rajasthan, Jaipur, Dr B. C. Joshi, the principal investigator, proposes to carry out chemical investigation of some xerophytic plants of Rajasthan, which are used by local people in the treatment of various diseases. After establishing their authenticity botanically, the extraction of organic constituents, determination of their structure and pharmacological studies of the constituents will be done. Efforts will also be made to synthesize constituents of medicinal importance.

Evolutionary Pattern of Enzymes Involved in Ascorbic Acid Biosynthesis

The ability of different species of animals to synthesize L-ascorbic acid has been found to be correlated with their phylogeny. In the more primitive species, viz. amphibians, reptiles and birds of the older order, synthesis of L-ascorbic acid occurs in the kidney. With the ascent of evolution the enzymic activity is transferred from kidney to the liver of mammals and some passeriformes birds. The biosynthetic capacity is then altogether lost by man and other primates and some highly evolved passeriformes birds. Since ascorbic acid is synthesized from glucose through the glucuronic acid pathway of metabolism, it would be highly interesting to examine the different enzyme systems in both the kidney and liver of animals in their phylogeny.

The object of a new CSIR scheme granted to Dr I. B. Chatterjee (principal investigator) at the Department of Biochemistry, University College of Science, Calcutta, is to study the following enzymes in both kidney and liver of different animals in the ascent of evolution:

(1) glucose-6-phosphatase: to be estimated by the release of inorganic phosphate from glucose-6-phosphate by the microsomes; (2) β-glucuronidase (hydrolyses conjugated glucuronides to free glucuronic acid): to be estimated by the release of phenolphthalein from phenolphthalein glucuronide; (3) uronlactonase and aldonolactonase (reversibly hydrolyse glucuronolactone and gulonolactone respectively): to be estimated by the disappearance of the lactones by the soluble supernatant; (4) enzymes converting conjugated D-glucurnolactone into L-ascorbic acid (very recently it has been observed in the investigator's laboratory that free D-glucuronolactone is not a substrate for the microsomal enzyme; glucuronolactone is acted only when it is conjugated): to study the activity of this microsomal enzyme by the amount of ascorbic acid formed from D-glucuronolactone semicarbazone; and (5) L-gulono oxidase (converts L-gulonolactone to 2-keto-L-gulonolactone which spontaneously isomerizes to ascorbic acid): to be studied by the oxygen uptake or by ascorbic acid formation or both using L-gulonolactone as substrate and microsomes as the source of enzyme.

Completed Schemes

Physics of Colloidal Plasmas and M. H. D. Power Generation

The electromagnetic properties of dust suspensions, commonly known as colloidal plasmas when the free electron density is appreciable, is a subject of recent interest. The electron density of such plasmas is controlled by the thermionic or photoelectric emission from the dust particles and the recombination of the electrons with them. The investigations in this field have found applications in magneto-hydrodynamic (M.H.D.) power generation, electromagnetic properties of flames and rocket exhausts, ionospheric physics and electrostatic precipitation. The electron density can be increased by the addition of dust of a material having a low work function, and can be decreased by the addition of dust of a high work function material. The present technology can produce dust with a particle size of 1/40 μ and hence such plasmas are within the realm of modern experimental techniques.

The use of noble gas-dust suspensions as a working fluid in closed cycle M.H.D. power generators using gas cooled reactors is known. Shri S. Guha, a CSIR research fellow at the Department of Physics, Indian Institute of Technology, New Delhi, has investigated under the guidance of Prof. M.S. Sodha, the possibility of increasing the conductivity of gas-dust suspension when it is illuminated by a strong source of light. It was found that a conductivity of about 2 mho/m is attainable at room temperature under normal operating conditions and hence can be measured easily to yield design data for the M.H.D. power generation experiments.

The analysis of electrical conduction in dust-laden gases has been suitably modified to investigate the dependence of electrical conductivity of additively coloured alkali halide crystals containing colloidal alkali metal particles on various relevant parameters. The conductivity of additively coloured alkali halide crystals is found to be many times larger than that in normal crystals. This excess conductivity was attributed to the thermionic emission of electrons from the colloidal metal particles into the conduction band of the crystal. The analysis of photoconductvity of such crystals was made and the results were found to be in qualitative agreement with the experimental observations.

The study of the electromagnetic wave propagation in colloidal plasma was also made using a more appropriate expression of electron

collision frequency. The results are likely to be useful in the understanding of the electromagnetic properties of rocket exhausts.

An analytical study of the optimum seeding of helium with cesium for obtaining maximum conductivity of the working fluid of M.H.D. power generators was carried out depending upon non-equilibrium ionization for its performance. The electron collision cross-section of the various atoms was assumed to be velocity dependent and hence the optimum seeding ratio was found to depend upon the operating parameters of the generator.

Data useful in the design of M.H.D. power generators, which utilize the elevated electron temperature, were also obtained.

Shri S. Guha, who carried out the work during July 1966-Dec. 1968, was awarded the Ph.D. degree (1969) of the Indian Institute of Technology, New Delhi for the thesis entitled 'Physics of colloidal plasmas and M.H.D. power generation'.

International Geotechnical Conference

At the invitation of the Iranian Geotechnical Institute, Shiraz, Iran, Prof. Dinesh Mohan, Director, Central Building Research Institute (CBRI), Roorkee participated in the International Geotechnical Conference held at Pahlavi University from 26 to 29 October 1970. The conference was attended by delegates from USA, Canada, UK, Hungary, Greece, Bulgaria, Turkey, Sweden, Austria, Israel and Thailand besides the Iranian delegates.

In the first technical session, Prof. F. E. Richart (USA) delivered a special lecture on the behaviour of soils under dynamic loads and described an interesting device for putting on dynamic loads by blasting a 12 ft column of water up in the air.

The second session started with a lecture by Prof. A. Kezdi (Hungary) on earth pressures, which included a detailed account of various model tests in the laboratory, measuring active and passive earth pressures corresponding to different types of wall movements. The lecture was followed by the presentation of papers by the foreign delegates. Prof. A. Loizos (Greece) spoke on the shear strength of sandy soils by *in-situ* vane shear tests. He claimed a good correlation between the values of vane shear strength of sandy soils and the values obtained by conventional methods. Prof. Borowicka (Austria) spoke on the shear strength of Vienese slickensided silty clays, which, in the remoulded form, gave satisfactory shearing strength results in the laboratory.

Prof. Dinesh Mohan presided over the third technical session and delivered a lecture on foundations on weak soils. He described the Central Building Research Institute's work relating to under-reamed piles in black cotton soil, compacted piles in weak soils and pre-loading of poor soils with the help of jacks.

On an invitation from Dr K. Pakdaman, Deputy Minister for Housing & Development, Government of Iran, Prof. Dinesh Mohan delivered a lecture on low cost housing with special reference to the work carried out at CBRI, Roorkee. He also visited two housing colonies built on Low Cost Housing Scheme, the Iranian Documentation Centre, Iranian Institute of Standards and Industrial Research and the Keraj Arch Dam.

BITM's New Gallery on Popular Science

A new gallery on Popular Science was inaugurated at the Birla Industrial and Technological Museum (BITM), Calcutta on 24 November 1970 by Prof. G. C. Sen, Vice-Chancellor of the Jadavpur University. With the help of some 80 static and working models and exhibits in the fundamental disciplines of mechanics, electricity, optics and sound the new gallery demonstrates the mechanism of hearing, seeing, working of the brain, etc. Equipment used in recording and reproduction of sound from the early Edison's phonograph to the latest high fidelity stereophonic record changer are displayed. A section on mechanics illustrates the principles involved in the transfer of momentum, pulley systems, sympathetic vibrations and the third law of motion. A panel on optics includes classical experiments on reflection, refraction, polarization and double refraction. Applications of these principles are also illustrated. Besides the newly opened gallery, there are 9 galleries, viz. Nuclear Physics; Motive Power; Mining; Copper; Iron and Steel; Petroleum; Electricity; Television and Electronics; and Communication.

Patents Accepted

Indian Pat. 12217

Improvements in or relating to soft ferrites for use in medium and short wave frequencies

C.V. Ganapathy, G. Govindaswamy, K. Narayana, S.M. Khullar, R. Ramchandran, H.S. Kalsi & P. Thomas

NPL, New Delhi

The patent relates to the improvements effected in the process for the preparation of nickel-zinc ferrite. By adding trace components —cobalt oxide and cerium oxide—to normal nickel-zinc ferrite and under-sintering, the ferrite, which finds use for medium wave frequency, acquires properties which make it useful for short wave frequencies also. In addition, the properties in the medium wave are considerably enhanced. The signal-to-noise ratio in these ferrites is better than in the imported variety.

Indian Pat. 118674

Preparation of concrete additives for increase of compressive strength and workability

G. P. Sastry, A. C. Khazanchi & M. S. Iyengar

RRL, Jorhat

Of all the factors, viz. nature of cement and aggregate, grading of particle sizes of the aggregate, proportion of cement, ratio of water to cement used, degree of compaction, etc., on which the quality of concrete depends, the most important is the water-to-cement ratio. This should be as low as possible consistent with adequate workability of the mix, for if the mix is too dry and harsh it cannot be properly compacted. The strength of concrete decreases with the increase in the proportion of water and if the water is reduced to the minimum level of 25-30% obtaining at the same time a workable mix, the concrete will have maximum strength.

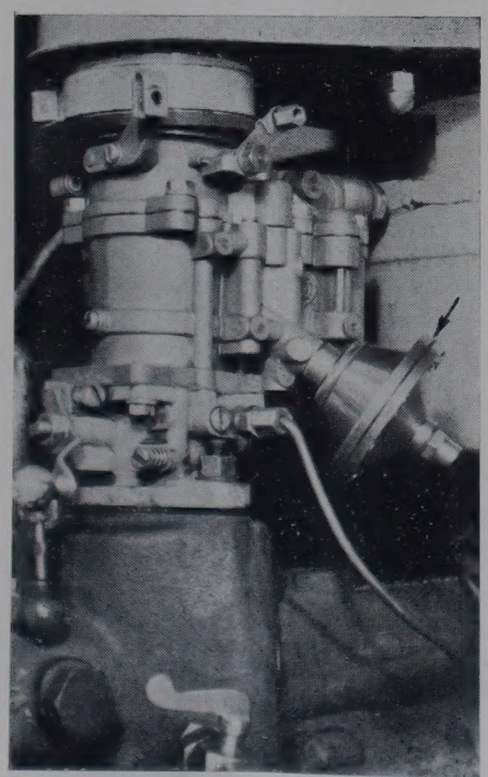
The invention covered by the patent under reference relates to the development of an additive which when mixed with concrete in plastic

state increases its workability and compressive strength by decreasing the water requirement. Hence, a lean mix can be made to give the strength of a rich mix with the admixture, thereby effecting saving in cement. The product is obtained from spent liquor (alkali lignin), a waste product obtained in kraft paper industries. Experiments have revealed that the product when added in very small proportions to the concrete mix increases compressive strength to the extent of 20% and reduces the water requirement to the extent of 30% of the total water requirement in the mix.

Indian Pat. 115206

High altitude automatic mixture corrector
N. V. Iyer, B.K. Rana & B.B. Joshi
IIP, Dehra Dun

Spark ignition engines fitted with conventional carburettors are handicapped due to power losses resulting from low atmospheric pressures and mixture enrichment. This invention relates to the development of a simple mixture correcting device which can be fitted to the original carburettor with minor modifications. The device automatically corrects the air-fuel ratio in the mixture with changes in altitude and is effective up to about 6000 m altitude above sea level. In principle, the device consists of a barometric pressure capsule of the diaphragm - type. The deflection of the diaphragm under the influence of the change in the ambient air pressure causes a calibrated fuel metering needle to restrict the opening of the metering jet, thus bringing about a change in the rate of flow of fuel to the engine. The modification involved of the carburettor is of such nature that the original metering jet is left in position, and thus the device once fitted can be left in position even at sea level. The device can be easily fabricated using indigenous materials and know-how. It can be used with great advantage in vehicles operating at high altitudes.



Fuel-air mixture corrector (*arrow*), developed by IIP, Dehra Dun, fitted to carburettor

Indian Pat. 120363

Process for extraction from commercial black cutch of a material that can be used instead of kattha in the preparation of *pan* and *pan masala*
J. G. Srivastava
NBG, Lucknow

Kattha (catechu, white catechu, *khair*) is used in the preparation of *pan* or *pan masala*. In addition to the indigenous production of about 3500 tonnes/annum, *kattha* is imported from Nepal, Indonesia, Malaysia, Singapore and Burma to the value of about Rs 36 lakhs/annum. The present invention seeks to utilize the commercial black cutch (*kala kattha*), a byproduct of *kattha* factories, for producing a good substitute for commercial *kattha* for use in the preparation of *pan* and *pan masala*. The indigenous production of commercial black cutch is about 3500 tonnes/annum, of which a small quantity is used for dyeing and calico printing, and dyeing and weighting chewing-tobacco leaves. Some of it is used as a mud chemical in deep oilwell drilling, but large quantities are exported at throw-away prices. The material could be processed by the method developed to yield about 2100 tonnes of *kattha* substitute. The process consists in dissolving black cutch in warm commercial acetone containing a few drops of Analar conc. hydrochloric acid. After cooling and distilling off excess solvent, the pasty mass is poured on petri-dishes and oven dried to expel the solvent completely. The orange brown shining residue is dissolved in hot water (3 vol.) and allowed to cool when a light brown pasty mass is obtained. This material gives a bright orange red colour in *pan* and *pan masala*.

The cost of production, including that of the raw materials, works out to less than one-third of the current market price of good quality *kattha*. The byproduct of the process can be used for tanning, dyeing and sizing.

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